

Graphics in the Large: Is Bigger Better?

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1 Introduction

The world of display devices is expanding rapidly, both literally and figuratively. New commercial and research devices come in larger sizes (measured in meters, not inches) and different physical forms (e.g. rectangular surfaces, cylindrical segments, truncated spheres). Such expansion means that graphics and interactive techniques are becoming far more amenable to group activities and can display more and more data at once.

This panel considers graphics in the large. We will examine large-sized graphics that can be displayed on multiple devices, devices that can be used by groups of co-located and distributed users, and the impact of displaying more and more data. The discussion will center on “Is Bigger Necessarily Better?”

1.1 Questions and Points for Debate

The motivation of this panel is recent work evaluating the impact of large display devices, rendering techniques, and interaction techniques (both single user and groups) for such devices.

The move toward large display devices parallels the information explosion fueled by pervasive, low cost computing. People continue to search for better ways in which they can better understand and use the huge amounts of information. The visual channel is one of the most obvious because the human vision system can accept and process pictures with amazing efficiency.

Larger and larger display devices are a natural step: people can understand more complexity and relationships when they see more. Potential applications abound because large screen devices can be used to display information in 2D or 3D. Complex 2D displays are common in command and control systems that manage power grids, computing networks, air traffic, and battlefield scenarios. The gaming and entertainment industries generate large numbers of 2D and 3D visual environments that millions view daily. Use of 3D has become commonplace. Companies that build physical products (e.g. automobiles, appliances, aerospace vehicles, buildings) rely on solid and surface geometry as the product data definition master. Display of the information in 3D has become essential in understanding geometry form, fit, and function. Information visualization techniques are invaluable for people who try to understand and analyze vast quantities of seemingly unrelated data.

The computer graphics community has made significant progress not only in large screen devices but also in graphical rendering techniques, particularly in enhancing the illusion of three dimensions. The techniques have been particularly effective for images projected onto large screens. Work still is being done to make three-dimensional images appear ‘better’.

A significant body of questions arises with the advent of larger and larger display devices. For example:

- In what situations are such devices beneficial, if any?
- What techniques can be used to prevent information overload?
- Are there ways for individuals to interact other than mouse and keyboard? How do we transition from a WIMP interface?
- Is there an effective way of allowing a group of users to interact with a single large display during a design or a review session?
- How does an individual work with multiple large devices that have different characteristics?

2 Loren Carpenter

Cinematrix systems have been installed in theme parks and millions of people have played games together. Cinematrix has also been extensively employed in the corporate theater market, energizing meetings, providing the actual *experience* of teamwork, and real-time statistical feedback to management. We have been studying what goes on ever since 1991 when the audience erupted. Rachel Carpenter's M.S. thesis describes the anthropological view of the audience experience. Over the past seven years we have come to understand some of the principles in effect during a computer-mediated collective group activity.

This panel's focus on large screen displays brings in Cinematrix because our events require a large screen to focus the attention of a large group. Attention focused on a common screen is needed for the synchronization that raises the energy in the room. It's precisely the difference between 500 people going to a movie theater or 500 people watching a movie on their TVs at home. Excitement and all the other emotions are contagious and non-linear with density, thus amplifying the experience.

One of the things we have discovered is that, in general, people *want to help*. There are deep historical reasons for this that will be described in detail. Also, there are cognitive elements that are essential to minimize the audience's learning curve. Finally, there are momentum and showmanship effects that need to be understood, or the audience will lose interest and drift away. Near and far future possibilities will be explored.

2.1 Panelist Carpenter Bio

Loren Carpenter is Senior Scientist at Pixar Animation Studios; and, with his wife Rachel, a founder of Cinematrix Interactive Entertainment Systems. He received the third SIGGRAPH Achievement Award for his image synthesis and display algorithms. In 1996, he was named an ACM Fellow. In March 2001, he received an Oscar for his pioneering efforts that led to the digital filmmaking revolution.

3 Brian Fisher

The choice of display environment must take into account the interaction between the proposed environment, the graphical characteristics of the images presented, and the performance

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characteristics of users' visual and motor control systems. In addition to drop-offs in acuity and color perception in peripheral vision, less well-known findings from research in spatial cognition (users' consciously accessible representation of visio-spatial information) and functional and apparent space constancy (their ability to compensate for changes in point of view for action and scene understanding respectively) are also important. Much of this is explained in the "two visual systems hypothesis" of Trevarthen that postulates neuroanatomically distinct parallel streams of processing in vision that operates differently.

From this perspective, large format displays have advantages over smaller displays only in certain situations. For example, the two visual systems hypothesis predicts that visual context illusions will have a larger impact on users in decontextualized (or large screen) immersive environments, particularly if users' interaction is determined by where they believe the display items to be (versus, for example, selecting them by pointing). Images that generate these illusions may be better viewed on a smaller screen. Of course, smaller displays are not necessarily better. Mental mapping analysis suggests situations where the ambient space constancy mechanism could better help users build a mental model of a large data space when sufficient peripheral information is present, i.e. in a large screen or immersive display environment.

3.1 Panelist Fisher Bio

Brian Fisher, Ph.D. (Experimental Psychology, University of California) is the Associate Director of the Media and Graphics Interdisciplinary Centre and Adjunct Professor in Computer Science, Commerce, and Psychology at the University of British Columbia. He serves on the UBC Brain Research Centre and the Institute for Computing, Intelligent and Cognitive Systems.

4 Richard May

Development of computer systems to support co-located collaboration has been gaining support in the research community for many years. However adapting the commonly used interface tools (mouse, keyboard, and desktop display) to support co-located collaboration is not possible. These interface devices were designed to support single user interactions, not the interactions of groups. These tools also focus the user's attention on the interface and away from other users or physical devices that are necessary for solving complex real-world problems. Additionally, these tools only support a limited (point, click, type) set of interactions that must be rigidly and uniformly applied.

The problem with designing group interfaces is an issue of design and configuration, not an issue of technology. Many technologies available today can be used to create innovative display and input devices. However, even a large-format computer screen with the resolution of printed material does not solve the problems of group interfaces. It is my position that group interface design would be greatly facilitated by applying interaction metaphors from the physical world for electronic data manipulation and by supporting situation specific interactions.

4.1 Panelist May Bio

Richard May is a final-year Ph.D. candidate while also maintaining his status as a senior researcher at Battelle. May's Ph.D. research is the definition, development, evaluation, and optimization of a group, direct-interaction environment. The environment uses video cameras to recognize both people and objects in the interaction space.

5 Norbert Streitz

My position on the issue of large screen displays results from the concepts and experiences with the "Roomware®" components we have developed over the last six years (www.roomware.de). By Roomware®, we mean computer-augmented room elements like doors, walls, furniture integrated with information technology. They are part of our approach that the "world around us" is the interface to information and for the cooperation of people. It requires an integrated design of real and virtual worlds augmenting reality. The computer disappears as a device and is almost "invisible," but the functionality is ubiquitously available. Thus, the roomware approach moves well beyond standard desktop environments.

One of many examples is the DynaWall®, an "interactive electronic wall" that is 4.5 m wide and 1.1 m high. Based on touch-sensitive screens, you write or draw directly on it with fingers or a regular pen and interact via gestures in a modelless interface using incremental gesture recognition. Due to the large dimensions, we developed new forms of human-computer interaction, e.g., "take and put" or "throw" and "shuffle" in order to move information objects from one side to the other.

Application scenarios include various types of supporting brainstorming and teamwork. For example i-LAND provides an interactive landscape for creativity and innovation. We have expanded these concepts to various other locations in the building in "Ambient Agoras: Dynamic Information Clouds in a Hybrid World" (www.ambient-agoras.org), part of the EU Disappearing Computer initiative. (www.disappearing-computer.net).

5.1 Panelist Streitz Bio

Norbert Streitz received an M.S. in Physics, a Ph.D. in Theoretical Physics (both University of Kiel) and a Ph.D. in Cognitive Psychology (Technical University Aachen). He is now head of research "AMBIENTE - Workspaces of the Future" of the Fraunhofer Institute IPSI in Darmstadt, Germany.

6 David J. Kasik

The problems of aerospace vehicle design stress the limits of a person's ability to understand complexity. The general rule of thumb has been that users can always understand any picture, especially one derived from a rendered 3D model, because the computer will run out of processing capacity before the person does. Compute capacity for rendering 3D models has increased substantially and makes graphic information overload possible.

The graphics industry has been producing some fascinating large display devices. With the increased compute power, we can now display larger parts of an airplane on a big screen. However, there has been little consideration whether users actually benefit or comprehend the increased amount of graphical information.

The graphics community can assess the effectiveness of products and interfaces in specific situations more systematically and earlier. We pay insufficient attention to interactive techniques and simplified graphical design. Instead, we often try to use a sledgehammer when a paintbrush would be more appropriate. Early assessments will drive better products for the industry and improve the ultimate usefulness of graphics for complex tasks.

6.1 Moderator Kasik Bio

Dave Kasik is a Boeing Technical Fellow and the Geometry and Visualization architect for Boeing Commercial Airplanes in Seattle WA. He has worked extensively in user interface software. He received an M.S. in Computer Science from the University of Colorado and a B.A. in Quantitative Studies from the Johns Hopkins University.